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PATENT

CERTIFICATE OF MAILING

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent: 6,984,795 B1

Dated: January 10, 2006

Inventor: Kowalik

For: CENTER BREAK SWITCH WITH REDUCED OPENING FORCE REQUIREMENT

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Sir:

REQUEST FOR CERTIFICATE OF CORRECTION DUE TO OFFICE MISTAKE - 37 CFR 1.322

The printed patent has the mistakes listed for correction on the accompanying Form PTO/SB/44.

The correction on the patent front sheet is to show correct additional references cited and considered by the Examiner consistent with the action of December 10, 2004, page 5 and applicants' reply dated January 27, 2005, page 9; see attached exhibits "x", "y", and "z".

The correction in column 4 is to make the patent consistent with the application at page 6, line 29; see attached exhibits "A" and "B".

The correction in column 5 is for consistency with the application at page 8, line 29; see attached exhibits "C" and "D".

The correction in column 7, line 26, is consistent with an examiner's amendment of April 21, 2005, page 2; see attached exhibits "E" and "F".

The correction in column 7, line 34, is consistent with the application at page 11, line 9; see attached exhibits "E" and "G".

The correction in column 9 is consistent with both the original and amended versions of claim 8; see exhibits "H", "I" and "J".

Copies of pertinent portions of the record accompany this paper.

Please issue a Certificate of Correction as presented on behalf of the assignee of the patentees.

Respectfully submitted,

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Encs.

PTO/SB/44 (04-05)
Approved for use through 04/30/2007. OMB 0651-0033
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,984,795 B1

APPLICATION NO.: 10/645,068

ISSUE DATE : January 10, 2006

INVENTOR(S) : Kowalik

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Patent Front Sheet

Under U.S. PATENT DOCUMENTS add:

-- 3,244,825 A * 4/1966 Killian et al.
3,627,939 A * 12/1971 Myers
4,795,869 A * 1/1989 Roman et al. --

Column 4

Line 44, change "6*b*" to -- 16*b* --.

Column 5

Line 63, change "comers" to -- corners --.

Column 7

Line 26, change "116" to -- 216 --.
Line 34, change "comers" to -- corners --.

Column 9

Line 4, change "lengths" to -- length --.

MAILING ADDRESS OF SENDER (Please do not use customer number below):

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US006984795B1

(12) **United States Patent**
Kowalik

(10) **Patent No.: US 6,984,795 B1**
(45) **Date of Patent: Jan. 10, 2006**

(54) **CENTER BREAK SWITCH WITH REDUCED OPENING FORCE REQUIREMENT**

(75) Inventor: **Peter M. Kowalik**, Trafford, PA (US)

(73) Assignee: **Cleaveland /Price Inc.**, Trafford, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 173 days.

(21) Appl. No.: **10/645,068**

(22) Filed: **Aug. 21, 2003**

(51) **Int. Cl.**
H01H 31/00 (2006.01)

(52) **U.S. Cl.** ..... **200/48 CB**

(58) **Field of Classification Search** ..... 200/48 R, 200/48 P, 48 KB, 48 SB, 48 CB, 49; 218/7, 218/14–21
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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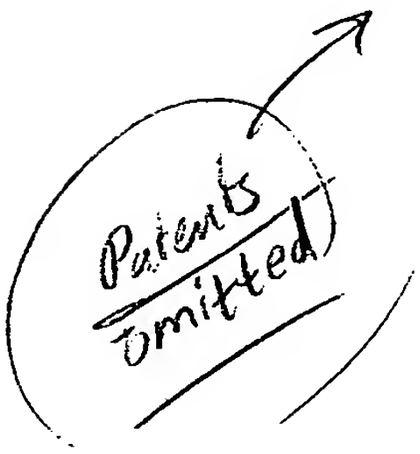
* cited by examiner

Primary Examiner—Marina Fishman
(74) *Attorney, Agent, or Firm*—Gordon H. Telfer

(57) **ABSTRACT**

A switch has respective open-assist bars fixed to switch blades near the switch contacts. The bars are arranged so that, as the blades are turned by rotation of their supports, the bars come together and serve as a fulcrum mechanism that provides a prying action helping reduce the required opening force. The action of the fulcrum mechanism overcomes friction between the contacts that may otherwise tend to cause bowing of the supports with appreciable increase in the required opening force.

20 Claims, 4 Drawing Sheets



Action dated 12/10/2004

Allowable Subject Matter

7. Claim 1 is allowable, except for the objection stated above.

8. Claims 2 and 5 -14 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. Claims 3 and 4 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: The prior art of record does not teach or suggest the combination of elements including "a pair of pry-bars, each attached to one of the blades proximate the contact and arranged with facing ends to work pivotally against each other."

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Hodder et al. [US 5,061,833], Upton, Jr. [US 3,348,002], Roman et al [US 4,795,869], Bagnagatti [US 2,835,756], Ransom [US 3,227,830], Killian et al. [US 4,244,825], Myer [US 3,627,939] and Bernatt [US 3,566,061] all disclose center break switch arrangement. Applicant also should consider these references in response to this office action. Should issue arise concerning the rejection presented above, these references may be relied upon in a subsequent action to support the lack of novelty or obviousness of claimed subject matter to one of ordinary skill in the art.

recognizing the opening force problem addressed by applicant (see, for example, page 2, line 31, to page 3, line 6) is presented.

It may also be noted that the elements of applicant's fulcrum mechanism preferably do not conduct when the switch is closed and even can be chosen to be insulative (page 11, lines 19-22) and need not have a role in the closing of the switch (page 4, lines 27-28). These are not limitations in claim 20 but are mentioned so there is no mistaking the totally different nature and purpose of the contacts of the reference with those of applicant's fulcrum mechanism. Therefore, neither anticipation nor obviousness can be based on this art.

Dependent claims 16-19 and 21 should be allowed along with claim 20 and contribute more to the patentable distinctions of the combinations claimed as a whole. For example, nothing in the contacts of Levi is a pair of bars that form a pivot axis as described in claim 16. New claim 21 spells out the pivot axis of the fulcrum mechanism is substantially fixed in location (see page 8, lines 27-30, for example). Nothing in Levi is like or suggestive to such an arrangement.

***

The above discussion has summarized and paraphrased some of the claim language for expediency with no intent to alter the actual scope of the claims.

The other cited prior art has been considered and found not to affect the patentability of the claims. That includes the art cited on page 5 of the action, as corrected by the Examiner by phone (patent "4,244,825" is meant to be 3,244,825).

the contacts to face each other. The facing portions abut and contact each other during a switch opening along with initial contact movement and before full separation. That is, the upper parts of an "L" on a right side blade and the upper part of a reverse "L" on a left side blade are located behind the contacts (with respect to the direction the contacts move) and the ends of the "L" and reverse "L" bars, which have some width and thickness, possibly with a flange-like end, meet to produce the intended effect.

While the contacts are engaged in sliding friction, the bars provide a new pivot point, or axis of rotation, during the opening motion that pries the contacts apart and forces them to stay on a more perfect arc as they open. The bars reduce bowing movement of the insulator supports and provide a contact parting at a point substantially like one that would exist if there were no sliding friction, even though the contacts do experience the same friction and wiping action.

The bars can be simply formed with the shape mentioned just as an example. Their conductivity is not an issue as far as producing the effect described. They need not touch in the fully closed position and need not have any direct contact with the switch contacts. (If the bars are metal, it is generally preferred to avoid any such contact.) They can be arranged to stay clear of any auxiliary switch elements near the contacts, such as arc horns, and may be attached at any convenient location along the blades, including at the same bolt locations arc horns are attached. Fortunately, the bars assist appreciably in an opening operation without interfering with a switch closing. They can be arranged to have little or no contact with each other during a closing operation and not appreciably alter the closing force.

The earlier contact release point that is achieved appreciably reduces the required operating force. A prototype test on a 230 kV, 3000 ampere switch showed a reduction in operating force on a handcrank gearbox (having a gear ratio of 20:1) from about 40 pounds without the bars to about 15 pounds with them in place, with the same contact pressure. Such switches have insulative supports over seven feet long and switch blades with a radius of about five feet.

The arrangement can be economical, effective, and readily implemented on switches already in service. It provides a convenient alternative, or a complement to other approaches that could be taken, such as providing a higher ratio gearbox for a handcrank operator.

Ancillary benefits include an opportunity to have higher contact pressure because the pry bars alleviate concern that less pressure should be maintained for easier opening. Also, flexibility of insulators can be less of a concern, so they can possibly be made from a wider range of materials.

These and other aspects of the present invention will be further understood from the following text and drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIGS. **1** and **2** are, respectively, side elevation and top plan views of a center break switch showing an embodiment of the invention where FIG. **2** omits for clarity elements of FIG. **1** below a top portion;

FIG. **3** is an enlarged plan view of part of the switch of FIGS. **1** and **2**;

FIG. **4** is an elevation view of the parts shown in FIG. **3**;

FIG. **5** is a plan view of the apparatus of FIGS. **3** and **4** during movement from a fully closed position;

FIG. **6** is a schematic plan view of three mechanically interconnected switches;

FIGS. **7** and **8** are partial plan views of two alternative embodiments; and

FIGS. **9** and **10** are, respectively, partial plan and elevation views of a further embodiment.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. **1**, **2**, **3**, **4**, and **5** are of the same apparatus although some elements are shown only in FIG. **1**. While each of FIGS. **1**, **2**, **3** and **4** show a fully closed switch position, FIG. **2** also shows a position after contact separation.

FIG. **1** shows a switch (one-pole) with a rigid base **10**, e.g., of hot-dip galvanized steel, on which moveable elements of the switch are mounted. Rotatable supports **12** and **13** are mounted at their bottom ends with bearings (not shown) for their rotation relative to the base **10**. In this example, the supports **12** and **13** each include a respective stack of insulators **12***a* and **13***a* with intermediate metal couplings **12***b* and **13***b*. The insulators **12***a* and **13***a* are generally of a polymer (e.g., fiber reinforced plastic) or a ceramic material. Even though they are not intended to flex, the insulators are subject to some inherent flexing due to the described friction effects.

Contact blades **14** and **15** are respectively joined to the upper ends of supports **12** and **13** (FIG. **1**). Near the supported ends of the contact blades **14** and **15** there is a respective one of a pair of line terminals **20** and **21** for connection with a conductor of an electrical system. Features for pivoting of the blades **14** and **15** in relation to the relatively fixed terminals **20** and **21** are included but will not be detailed herein and may be the same as prior art. The blades **14** and **15** have ends away from the supports **12** and **13** with blade ends, contacts and members to assist in switch opening (to be discussed later) in an assembly identified collectively by reference numeral **50** in FIGS. **1** and **2** with more detailed identification of the elements in the subsequent enlarged views.

The blades **14** and **15** are, for example, each a single piece, aluminum, square tube. Each blade **14** and **15** has one of a pair of switch contacts **16** and **17** at its end opposite its respective support **12** or **13**.

In this example, as shown in FIGS. **3** and **4**, the left side contact **16** includes four pairs of conductive fingers: two upper pairs each having a top finger **16***a* and a bottom finger **16***b* and two lower pairs each having a top finger **16***c* and a bottom finger **16***d*, all of which are conductively joined near their left ends to the blade **14**.

The right side contact **17** includes a pair of conductive stabs **17***a* and **17***b*, both conductively joined near their right ends to the blade **15**, that are respectively captured (in the closed position) within a jaw formed by the upper pairs of contact fingers **16***a* and **16***b* and within a jaw formed by the lower pairs of contact fingers **16***c* and **16***d*. The elements of contacts **16** and **17** are highly conductive, e.g., silver plated or silver overlaid copper.

In addition, there is a contact pressure adjusting mechanism **18**, such as one supported from the blade **14** with bolts and adjusting nuts bearing on spring plates that bear against the fingers of contact **16**.

The figures omit for greater clarity corona or arc reducing spheres or horns, and also an ice shield, that are conventionally arranged near contacts of such a switch as that shown.

At the bottom of the switch (FIG. **1**) a mechanism **30** is provided for operation of the switch including a tie rod **31** mechanically coupled to both insulative supports **12** and **13** at metal flange members not detailed here. Bearings (not

DETAILED DESCRIPTION OF THE INVENTION

Figs. 1, 2, 3, 4, and 5 are of the same apparatus although some elements are shown only in Fig. 1. While each of Figs. 1, 2, 3 and 4 show a fully closed switch position, Fig. 2 also shows a position after contact separation.

Fig. 1 shows a switch (one-pole) with a rigid base 10, e.g., of hot-dip galvanized steel, on which moveable elements of the switch are mounted. Rotatable supports 12 and 13 are mounted at their bottom ends with bearings (not shown) for their rotation relative to the base 10. In this example, the supports 12 and 13 each include a respective stack of insulators 12a and 13a with intermediate metal couplings 12b and 13b. The insulators 12a and 13a are generally of a polymer (e.g., fiber reinforced plastic) or a ceramic material. Even though they are not intended to flex, the insulators are subject to some inherent flexing due to the described friction effects.

Contact blades 14 and 15 are respectively joined to the upper ends of supports 12 and 13 (Fig. 1). Near the supported ends of the contact blades 14 and 15 there is a respective one of a pair of line terminals 20 and 21 for connection with a conductor of an electrical system. Features for pivoting of the blades 14 and 15 in relation to the relatively fixed terminals 20 and 21 are included but will not be detailed herein and may be the same as prior art. The blades 14 and 15 have ends away from the supports 12 and 13 with blade ends, contacts and members to assist in switch opening (to be discussed later) in an assembly identified collectively by reference numeral 50 in Figs. 1 and 2 with more detailed identification of the elements in the subsequent enlarged views.

The blades 14 and 15 are, for example, each a single piece, aluminum, square tube. Each blade 14 and 15 has one of a pair of switch contacts 16 and 17 at its end opposite its respective support 12 or 13.

In this example, as shown in Figs. 3 and 4, the left side contact 16 includes four pairs of conductive fingers: two upper pairs each having a top finger 16a and a bottom finger 16b and two lower pairs each having a top finger 16c and a bottom finger 16d, all of which are conductively joined near their left ends to the blade 14.

shown) for rotation of the supports **12** and **13** relative to the rigid base **10** are located near the attachments of rod **31**.

In this example, the mechanism **30** further includes a handcrank **32** schematically shown in a mechanically coupled relation through a gearbox **33** to the tie rod **31** that transmits rotational force to the supports **12** and **13**, both together and also typically together with force transmitted to two other switch poles of the same nature, as is later discussed in connection with FIG. **6**.

All of the elements discussed so far (not including any open-assist members **40** and **42** as described below) may be in accordance with known prior art switches such as, but not limited to, that described in the above mentioned background publication which is incorporated by reference herein for further description of examples of the construction and use of such switches, including both those with substantially parallel rotatable supports (as shown here) and those with substantially V-oriented supports (not shown herein) with otherwise similar features.

While the invention is not so limited; the contacts **16** and **17** in this example have fingers and stabs that engage each other in one or more planes parallel to the arcuate movement of the blades **14** and **15**; a substantially horizontal interface. (FIG. **2** gives a general picture of the blades and contacts as they have been moved from a closed to a contact parted position by rotation at their supports.) The contact fingers **16***a*–**16***d* are not totally planar, since (as shown in FIG. **4**) they have a bend that makes the principal direct contact with the stabs **17***a* and **17***b* along a line **52** (in the closed switch position). Before the switch reaches a position as shown in FIG. **2**, those bends of the fingers move over the surfaces of the stabs with a wiping action that is favorable for good conduction. The contact pressure adjustment mechanism **18** allows a user to set the pressure to a desired level.

(For general reference, switches of the type described typically go to a fully open position only after the blades have turned 90°. In views such as FIG. **2**, the contacts have parted and have no more frictional engagement but the blades have not yet reached the fully open position.)

FIGS. **3** to **5** show a contact assembly **50** that, in addition to the elements that may be otherwise conventional, include a pair of plate-like bars **40** and **42** that are shown respectively attached (e.g., bolted) near a first end **40***a* and **42***a* to the top of a switch blade **14** or **15** and shaped to extend in front of the contacts **16** and **17** to face each other at their ends **40***b* and **42***b* that may have small flanges, as shown.

The bars **40** and **42** need not make physical contact to each other in the fully closed position of the switch, so a gap may occur as shown in FIG. **3**. (The "facing" relation is meant to include either with or without a gap). The bars **40** and **42** assist in switch opening. When blade rotation and contact movement has started, the bars **40** and **42** meet at at least part of their facing ends **40***b* and **42***b* (e.g., edge corners **40***c* and **42***c* as shown in FIG. **5**) and establish there a new pivot or axis of rotation that facilitates switch opening. The line (or plane) **52** of principal contact engagement and wiping action shifts as the blades move in the directions of the arrows in FIG. **5**.

Now, instead of contact sliding friction causing bowing of the supports **12** and **13** so the switch opening is delayed due to extra travel of the contacts **16** and **17** and requires more force, the locus of the pivot corners **40***c* and **42***c* stays substantially fixed through the duration of their contact to each other despite the contact friction.

By way of further example, the bars **40** and **42** are relatively stiff metal plates that are relatively flat although FIG. **4** shows a small angular variation and the abutting ends **40***b* and **42***b* have small vertical flanges. These bars are, looking in the plane of FIG. **3**, respectively substantially L-shaped (bar **42**) and reverse L-shaped (bar **40**) with the bottom leg of each "L" joined at **40***a* and **42***a* to the respective blades and the ends of the top parts of the "L" configurations being the facing ends **40***b* and **42***b*.

One factor making it convenient to attach the bars **40** and **42** to the blades as shown is that the bar ends **40***a* and **42***a* can be bolted to the blades at bolt locations as shown that are the same as those used for attachment of arc horns (which are not shown in these views). This is particularly convenient for putting the assembly together on switches already in the field. A variety of other attachment locations and shapes for members performing the function of bars **40** and **42** will be apparent.

FIG. **6** illustrates a three phase switch combination with respective switches **61**, **62** and **63** that can each be like that previously described. This schematically shows how a single mechanical arrangement **130** combining tie rods and related parts of each of the three switches are joined together for common operation from a single motive power source, e.g., a handcrank **132** and gearbox **133**. This is a common situation and is shown to make the point that the inventive combination has further benefit when practiced in multi-switch gangs where opening force requirements are greater than with a single switch.

The described embodiment is also one that has the facing ends **40***b* and **42***b* that form the pivot point or axis, where corners **40***c* and **42***c* meet per FIG. **5**, off of the line **52** of the main contact pressure. This is just one possible location. A general characteristic of the inventive combination is that members comprising the fulcrum mechanism, such as bars **40** and **42**, meet and make a pivot point for the blades **14** and **16** at least some part of the time the contacts **16** and **17** are sliding together during a switch opening. Preferably, but not necessarily, the fulcrum mechanism is such that its pivot action occurs substantially throughout the sliding engagement of the contacts. Some benefit can be obtained even if it occurs only part of that time, for example during early contact movement. After the contacts have parted, the fulcrum mechanism need not operate.

FIG. **7** shows an alternative arrangement **150** for pivot members or bars on a switch with other elements as previously described. In this embodiment, the configuration of the blades **14** and **15** and the contacts **16** and **17** is the same as was previously described. The contacts **16** and **17** have a horizontal interface and move in the same direction as the contacts of FIG. **5**. However, now pivot members **140** and **142** are attached to respective contact blades **14** and **16** on the side of the blades toward the front of the switch (considering a view such as that of FIG. **1**) near their ends **140***a* and **142***a*. The members **140** and **142** are plate-like bars that, in this example, are shown just flat and their ends **140***b* and **142***b* face each other, with a small gap in the closed position. As shown, bars **140** and **142** are equal in length; in general, they can have the same or different shape and size as long as their locations cause the described pivot action. In FIG. **7**, as the switch opens, with blade movement as shown by the arrows, the pivot axis will occur at rear (or lower in the drawing) corner edges **140***c* and **142***c*, substantially as it does in the embodiment of FIG. **5**. FIG. **7** represents just one alternative form a fulcrum mechanism can take with contacts having horizontal engagement.

FIG. **8** shows a further alternative arrangement **150'**. A fulcrum mechanism comprises elements **140'** and **142'** that

the arcuate movement of the blades 14 and 15; a substantially horizontal interface. (Fig. 2 gives a general picture of the blades and contacts as they have been moved from a closed to a contact parted position by rotation at their supports.) The contact fingers 16a-16d are not totally planar, since (as shown in Fig. 4) they have a bend that makes the principal direct contact with the stabs 17a and 17b along a line 52 (in the closed switch position). Before the switch reaches a position as shown in Fig. 2, those bends of the fingers move over the surfaces of the stabs with a wiping action that is favorable for good conduction. The contact pressure adjustment mechanism 18 allows a user to set the pressure to a desired level.

(For general reference, switches of the type described typically go to a fully open position only after the blades have turned 90°. In views such as Fig. 2, the contacts have parted and have no more frictional engagement but the blades have not yet reached the fully open position.)

Figs. 3 to 5 show a contact assembly 50 that, in addition to the elements that may be otherwise conventional, include a pair of plate-like bars 40 and 42 that are shown respectively attached (e.g., bolted) near a first end 40a and 42a to the top of a switch blade 14 or 15 and shaped to extend in front of the contacts 16 and 17 to face each other at their ends 40b and 42b that may have small flanges, as shown.

The bars 40 and 42 need not make physical contact to each other in the fully closed position of the switch, so a gap may occur as shown in Fig. 3. (The "facing" relation is meant to include either with or without a gap). The bars 40 and 42 assist in switch opening. When blade rotation and contact movement has started, the bars 40 and 42 meet at at least part of their facing ends 40b and 42b (e.g., edge corners 40c and 42c as shown in Fig. 5) and establish there a new pivot or axis of rotation that facilitates switch opening. The line (or plane) 52 of principal contact engagement and wiping action shifts as the blades move in the directions of the arrows in Fig. 5.

Now, instead of contact sliding friction causing bowing of the supports 12 and 13 so the switch opening is delayed due to extra travel of the contacts 16 and 17 and requires more force, the locus of the pivot corners 40c and 42c stays substantially fixed through the duration of their contact to each other despite the contact friction.

are respectively integral with the blades **14'** and **15'**. For example, blades in the form of square tubes can have three sides partly cut away leaving portions **140'** and **142'** extending from the full square configuration. The extended material can be formed as desired, such as to form the illustrated flange portions at **140***b*' and **142***b*' that face each other and whose back corners **140***c*' and **142***c*' initially engage to provide a pivot as the contacts open.

A variety of contact arrangements for center break switches are used in the art other than that shown for contacts **16** and **17**. Some have principal contact engagement and a degree of wiping action that is not in a plane parallel to the arcuate blade movement. For example, the contact faces may principally engage in a substantially vertical interface plane. Even so, to the extent the contacts engage with sliding friction in any of these alternative contact configurations, the present invention can be beneficial to facilitate switch opening.

FIGS. **9** and **10** show an example of a combination **250** of pry bars with a pair of contacts with a vertical interface. Blade **214** supports a first contact **216** that has a loop forming a jaw within which a stab-like second contact **217** on blade **215** is engaged. A closed switch is shown. The arrows in FIG. **9** show the directions the blades **214** and **215** will take during a switch opening. During that movement front and back fingers of contact **116** slide against front and back ends of contact **217** and produce sliding friction.

The combination **250** includes pry bars **240** and **242** that are arranged and operate in substantially the same way as bars **40** and **42** previously described. Here the bars **240** and **242** are merely flat from their secured ends **240***a* and **242***a* out to their facing ends **240***b* and **242***b* at which a small vertical flange occurs. Also, it will be noted the bars **240** and **242** will meet and pivot, at the back comers **240***c* and **242***c*, along the same line as that on which the contacts engage in the closed position.

It is, therefore, apparent that the invention applies either in the case in which the contacts engage with sliding friction in a plane orientated the same as the plane of the movement of the blades or the case in which the plane of contact engagement is perpendicular to the blades' plane of motion. Also, it can be understood that the contacts can be configured with elements such that they engage, and slide, in both planes.

Among the considerations for members in the fulcrum, or open-assist, mechanism is to make any gap between them in the closed position as small as reasonably attainable so the pivot action can commence promptly upon contact movement. The gap can be avoided entirely although it is not generally preferred to have any conduction across the bars, if of metal, when closed. However, the bars need not be metal but may instead be of an insulative material such as fiber reinforced plastic, at least at the facing ends, so direct contact when closed would not be a concern.

The illustrated embodiments have a geometry for the open-assist elements with a pivot axis centered in relation to the blades and the blade supports although the contacts have a line of primary engagement, as shown in FIGS. **3**, **7**, and **8**, not quite centered between the ends of blades **14** and **15** or **14'** and **15'**. Symmetrical elements **40** and **42**, **140** and **142**, and **140'** and **142'** are generally preferred for typical switches, such as those with equal length blades. Variations can be implemented in which the abutting elements are not symmetrical; in general, they can have the same or different shape and size, and the same or different relative locations on the blades, as long as they meet to perform the described pivot action during the sliding engagement of the contacts.

While the description sometimes refers to "upper", "lower", "top" or "bottom", "horizontal" or "vertical" orientations (consistent with the Figures), it will be understood the described switches can be mounted in essentially any orientation.

The specific embodiments disclosed are merely some examples of the various ways in which the invention can be practiced.

What is claimed is:

1. A center break switch comprising:

a base;

a pair of switch blades, each having a switch contact and each mounted on the base by a rotatable support structure combined with an operating mechanism that moves the switch blades and their contacts between closed and open positions upon application of a motive force to the operating mechanism, each switch blade also having a line terminal;

the support structure and operating mechanism being related for rotation of each blade's support structure proximate the base with resulting movement of the blades and contacts arcuately between the closed and open positions; and

a pair of pry bars, each of the pair being attached to one of the blades proximate the contact with the bars arranged to have facing ends that work pivotally against each other during at least part of a switch opening operation of the operating mechanism to facilitate opening of the contacts.

2. The switch of claim **1**' where:

the pry bars, at their facing ends, are located, relative to the contacts on the blades, opposite the direction of movement of the contacts during switch opening.

3. The switch of claim **1** in a combination further comprising:

two additional center break switches each with a pair of switch blades and related contacts, a pair of pry bars, each of the pair of pry bars being attached to one of the blades proximate the contact with the bars arranged to have facing ends that work pivotally against each other during at least part of a switch opening operation of the operating mechanism to facilitate opening of the contacts, a pair of line terminals and a pair of support structures, with each of the three pairs of blades of the three switches being connectable at their line terminals to a respective phase of a three-phase electrical system; and

the operating mechanism includes elements joined together for common operation of all three switches by a single source of motive power.

4. The combination of claim **3** where:

the operating mechanism includes a manual operator or a motor operator.

5. The switch of claim **1** where:

the switch contacts engage each other with sliding friction during a period of movement of the switch blades from the closed to open positions.

6. The switch of claim **5** further comprising:

a contact tightening mechanism that allows adjusting the pressure on the contacts in the closed position to a desired amount.

7. The switch of claim **5** where:

the contacts, at least in part, have a configuration with mutual engagement in a plane substantially the same as that in which the arcuate movement of the blades occurs.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Attorney Gordon H. Telfer on April 11, 2005.

The application has been amended as follows:

SPECIFICATION:

Page 11, line 4, change "116" to -- 216 --.

2. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marina Fishman whose telephone number is 571-272-1991. The examiner can normally be reached on 7-5 M-T.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Elvin Enad can be reached on 571-272-1990. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

loop forming a jaw within which a stab-like second contact 217 on blade 215 is engaged. A closed switch is shown. The arrows in Fig. 9 show the directions the blades 214 and 215 will take during a switch opening. During that movement, front and back fingers of contact 216 slide against front and back ends of contact 217 and produce sliding friction.

The combination 250 includes pry bars 240 and 242 that are arranged and operate in substantially the same way as bars 40 and 42 previously described. Here the bars 240 and 242 are merely flat from their secured ends 240a and 242a out to their facing ends 240b and 242b at which a small vertical flange occurs. Also, it will be noted the bars 240 and 242 will meet and pivot, at the back corners 240c and 242c, along the same line as that on which the contacts engage in the closed position.

It is, therefore, apparent that the invention applies either in the case in which the contacts engage with sliding friction in a plane orientated the same as the plane of the movement of the blades or the case in which the plane of contact engagement is perpendicular to the blades' plane of motion. Also, it can be understood that the contacts can be configured with elements such that they engage, and slide, in both planes.

Among the considerations for members in the fulcrum, or open-assist, mechanism is to make any gap between them in the closed position as small as reasonably attainable so the pivot action can commence promptly upon contact movement. The gap can be avoided entirely although it is not generally preferred to have any conduction across the bars, if of metal, when closed. However, the bars need not be metal but may instead be of an insulative material such as fiber reinforced plastic, at least at the facing ends, so direct contact when closed would not be a concern.

The illustrated embodiments have a geometry for the open-assist elements with a pivot axis centered in relation to the blades and the blade supports although the contacts have a line of primary engagement, as shown in Figs. 3, 7, and 8, not quite centered between the ends of blades 14 and 15 or 14' and 15'. Symmetrical elements 40 and 42, 140 and 142, and 140' and 142' are generally preferred for typical switches, such as those with equal length blades. Variations can be implemented in which the abutting elements are not symmetrical; in general, they can have the same or different shape and size, and the same or different relative locations on the blades, as long as they meet to perform the described pivot action during the sliding engagement of the contacts.

8. The switch of claim 5 where:

the support structure of each blade is insulative and extends a length from the base with an axis of rotation running along the lengths.

9. The switch of claim 8 where:

the pry bars each comprise a rigid member secured to the respective blades so extremities of the bars face each other in the fully closed position of the switch contacts and mechanically engage as a pivot axis for a time during which the contacts engage with sliding friction.

10. The switch of claim 9 where:

the bars are secured to the blades at locations for attachment of additional elements for arc suppression.

11. The switch of claim 9 where:

the bars are of metal and are shaped and are attached to the blades with space avoiding any direct contact to the switch contacts and with a small gap, in the fully closed position, avoiding direct contact to each other.

12. The switch of claim 11 where:

the bars each have a flange-like portion at the extremities.

13. The switch of claim 9 where:

the bars, at least the extremities thereof, are insulative and are arranged with either a small gap or no gap between them in the closed position.

14. The switch of claim 9 where:

the bars are plate-like members substantially parallel to the plane of arcuate movement of the switch blade; and

the extremities of the plate-like members each have a corner edge, on the side thereof away from the contacts, that engage to provide the pivot axis.

15. A switch comprising:

a pair of switch contacts;

a pair of supports that each support one of the switch contacts;

a switch operating mechanism related with the contacts and their supports for relative motion of the contacts in an arcuate path including motion, in a switch opening, from a fully closed position in which the contacts are

stationary and conductively engaged, through a partly open position in which the contacts have relative motion while conductively engaged with sliding friction, to an open position in which the contacts are separated; and

a fulcrum mechanism comprising elements, in addition to the switch contacts, located proximate to and behind the contacts in relation to the path of relative motion, that meet to provide a prying action increasing leverage to help overcome the sliding friction between the contacts in movement through the partly open position.

16. The switch of claim 15 where:

the elements of the fulcrum mechanism form a pivot axis that is substantially fixed in location while the contacts are engaged with sliding friction in the partly open position.

17. The switch of claim 15 where:

the elements of the fulcrum mechanism comprise a pair of bars respectively attached to a pair of contact blades and the bars engage each other and together form a pivot axis to provide the prying action as the switch contacts slide against each other in the partly open position.

18. The switch of claim 15 where:

the contacts have frictional engagement during switch opening in a first plane in which the blades move during rotation of the supports or a second plane perpendicular to the first plane, or in both planes.

19. The switch of claim 17 where:

the fulcrum mechanism comprises a pair of members respectively attached to each of the pair of contact blades.

20. The switch of claim 17 where:

the fulcrum mechanism comprises a pair of elements respectively integral with each of the pair of contact blades.

* * * * *

5. The switch of claim 1 where:

the switch contacts engage each other with sliding friction during a period of movement of the switch blades from the closed to open positions.

6. The switch of claim 5 further comprising:

a contact tightening mechanism that allows adjusting the pressure on the contacts in the closed position to a desired amount.

7. The switch of claim 5 where:

the contacts, at least in part, have a configuration with mutual engagement in a plane substantially the same as that in which the arcuate movement of the blades occurs.

8. The switch of claim 5 where:

the support structure of each blade is ~~insulative~~ and extends a length from the base with an axis of rotation running along the length; ~~and~~

~~the~~ axes of the pair of blade support structures are either substantially ~~parallel to each other~~ or are substantially in a V configuration with the bottom of the V ~~located at the base of the switch.~~

[redacted]

9. The switch of claim 8 where:

the pry bars each comprise a rigid member secured to the respective blade so extremities of the bars face each other in the fully closed position of the switch contacts and mechanically engage as a pivot axis for a time during which the contacts engage with sliding friction.

10. The switch of claim 9 where:

the bars are secured to the blades at locations for attachment of additional elements for arc suppression.

11. The switch of claim 9 where:

the bars are of metal and are shaped and are attached to the blades with space avoiding any direct contact to the switch contacts and with a small gap, in the fully closed position, avoiding direct contact to each other.

12. The switch of claim 11 where:

the bars each have a flange-like portion at the extremities.

[redacted]

8. (Currently amended) The switch of claim 5 where:

the support structure of each blade is insulative and extends a length from the base with an axis of rotation running along the length~~, and~~

~~the axes of the pair of blade support structures are either substantially parallel to each other or are substantially in a V configuration with the bottom of the V located at the base of the switch~~.

9. (Original) The switch of claim 8 where:

the pry bars each comprise a rigid member secured to the respective blades so extremities of the bars face each other in the fully closed position of the switch contacts and mechanically engage as a pivot axis for a time during which the contacts engage with sliding friction.

10. (Original) The switch of claim 9 where:

the bars are secured to the blades at locations for attachment of additional elements for arc suppression.

11. (Original) The switch of claim 9 where:

the bars are of metal and are shaped and are attached to the blades with space avoiding any direct contact to the switch contacts and with a small gap, in the fully closed position, avoiding direct contact to each other.

12. (Original) The switch of claim 11 where:

the bars each have a flange-like portion at the extremities.

13. (Original) The switch of claim 9 where:

the bars, at least the extremities thereof, are insulative and are arranged with either a small gap or no gap between them in the closed position.